



2014 AASHTO PROVISIONAL STANDARDS

18TH EDITION

June 2014 Edition—AASHTO Provisional Standards



**Approved for Publication by the
AASHTO Highway Subcommittee on Materials**

**Published by the
American Association of State Highway and
Transportation Officials**

Front cover photos appear courtesy of the AASHTO Materials Research Laboratory (AMRL), Frederick, MD.

© 2014 by the American Association of State Highway and Transportation Officials. *All rights reserved.* Printed in the United States of America. This book or parts thereof may not be reproduced in any form without written permission of the publishers.

ISBN 978-1-56051-607-1

Published by the
American Association of State Highway and Transportation Officials
444 N. Capitol Street, N.W.
Suite 249
Washington, D.C. 20001
(202) 624-5800
www.transportation.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

EXECUTIVE COMMITTEE 2013–2014

President: Mike Hancock, Kentucky

Vice President: John Cox, Wyoming

Secretary-Treasurer: Carlos Bracerias, Utah

Regional Representatives:

REGION I: Chris Clement, New Hampshire, One-Year Term
Shailen Bhatt, Delaware, Two-Year Term

REGION II: Sherri LeBas, Louisiana, One-Year Term
John Schroer, Tennessee, Two-Year Term

REGION III: Paul Trombino, Iowa, One-Year Term
Ann L. Schneider, Illinois, Two-Year Term

REGION IV: John Halikowski, Arizona, One-Year Term
Malcolm Dougherty, California, Two-Year Term

Immediate Past President: Michael P. Lewis, Rhode Island

AASHTO Executive Director: Bud Wright, Washington, DC

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

HIGHWAY SUBCOMMITTEE ON MATERIALS

2013–2014

Mostafa Jamshidi, NEBRASKA, Chairman
Georgene Geary, GEORGIA, Vice Chairman
Jack Springer, FHWA, Secretary

ALABAMA

Bernard E. (Buddy) Cox, Materials and
Tests Engineer, Alabama Department
of Transportation
1409 Coliseum Boulevard
Montgomery, AL 36110

Lyndi Blackburn, Assistant Bureau
Chief

ALASKA

Michael San Angelo, State Materials
Engineer, Alaska Department of
Transportation and Public Facilities
5800 E. Tudor Road
Anchorage, AK 99507-1225

R. Scott Gartin, State Quality
Assurance Engineer

ARIZONA

Bill Hurguy, State Engineer, Materials
Group, Arizona Department of
Transportation
1221 North 21st Avenue
Phoenix, AZ 85009

Paul Burch, Chief Pavement Design
Engineer, Manager

Julie Klierer, Assistant State Engineer

ARKANSAS

Michael C. Benson, State Engineer of
Materials Division, Arkansas State
Highway and Transportation
Department
P.O. Box 2261
Little Rock, AR 72203

Emanuel Banks, Assistant Chief
Engineer, Operations

CALIFORNIA

Phil Stolarski, Division of Materials
Engineering and Testing Services,
California Department
of Transportation
5900 Folsom Boulevard
Sacramento, CA 95819-4612

COLORADO

R. Bill Schiebel, Materials and
Geotechnical Branch Manager,
Colorado Department of Transportation
4670 Holly Street, Unit A
Denver, CO 80216-6408

CONNECTICUT

Robert G. Lauzon, Principal Engineer
(Materials), Connecticut
Department of Transportation
280 West Street
Rocky Hill, CT 06067-3502

James Connery, Construction Division
Chief

DELAWARE

Jennifer Pinkerton, Chief Materials and
Research Engineer, Delaware
Department of Transportation
P.O. Box 778
Dover, DE 19903-0778

DISTRICT OF COLUMBIA

Wasi U. Khan, Chief, QA/QC
Materials Division, District of
Columbia Department of Transportation
2000 14th Street, N.W., Room N-401A
Washington, DC 20009

FLORIDA

Timothy Ruelke, Office of Materials,
Florida Department of Transportation
5007 N.E. 39th Avenue
Gainesville, FL 32609-2604

GEORGIA

Georgene M. Geary, State Research
Engineer, Georgia Department of
Transportation
15 Kennedy Drive
Forest Park, GA 30297

Charles A. (Chuck) Hasty, State
Materials Engineer

Peter Wu, Assistant State Materials and
Research Engineer

HAWAII

JoAnne Nakamura, Bituminous
Engineer, Materials Testing and
Research Branch, Hawaii Department
of Transportation
2530 Likelike Highway
Honolulu, HI 96819

Gerobin Carnate, Structural Materials
Engineer

IDAHO

Michael Santi, Materials Engineer,
Idaho Transportation Department
P.O. Box 7129
Boise, ID 83707-1129

ILLINOIS

Laura R. Mlacnik, Acting Engineer of
Materials and Physical Research
Illinois Department of Transportation
126 E. Ash Street
Springfield, IL 62704-4766

Matt Mueller, Engineer of Tests

Vickie Prill, Chief Chemist

INDIANA

Ronald P. Walker, Chief, Office of
Materials Management, Indiana
Department of Transportation
120 S. Shortridge Road
Indianapolis, IN 46219

IOWA

Greg Mulder, Director, Office of
Construction and Materials, Iowa
Department of Transportation
800 Lincoln Way
Ames, IA 50010

KANSAS

Richard E. Kreider Jr., Chief, Bureau of
Materials and Research, Kansas
Department of Transportation
Dwight D. Eisenhower State Office
Building
700 S.W. Harrison Street
Topeka, KS 66603-3754

KENTUCKY

Allen H. Myers, Director, Division
of Materials, Kentucky
Transportation Cabinet
1227 Wilkinson Boulevard
Frankfort, KY 40601-1226

LOUISIANA

Christopher D. Abadie,
Materials Engineer Administrator,
Louisiana Department of
Transportation and Development
5080 Florida Boulevard
Baton Rouge, LA 70806

MAINE

Richard Bradbury, Director of
Materials Testing and Exploration,
Maine Department of Transportation
16 State House Station
Augusta, ME 04333-0016

MARYLAND

Timothy E. Smith, Director, Office of
Materials and Technology, Maryland
State Highway Administration
7450 Traffic Drive, Building #4
Hanover, MD 21076

Woodrow L. Hood, Materials
Management Division Chief

Mark Wolcott, Deputy Director for
Material Engineering

MASSACHUSETTS

John E. Grieco, Director of Research
and Materials, Massachusetts
Department of Transportation,
400 D Street
South Boston, MA 02110

MICHIGAN

John F. Staton, Materials Engineer,
Construction and Technology Division,
Michigan Department of Transportation
8885 Ricks Road,
P.O. Box 30049
Lansing, MI 48909

MINNESOTA

Keith L. Shannon, Director, Office of
Materials and Road Research,
Minnesota Department
of Transportation
1400 Gervais Avenue, Mailstop 645
Maplewood, MN 55109-2044

Curt Turgeon, Pavement Engineer

MISSISSIPPI

James A. Williams, Assistant Chief
Operations Engineer, Mississippi
Department of Transportation
P. O. Box 1850
Jackson, MS 39215-1850

MISSOURI

David D. Ahlvers, State Construction
and Materials Engineer, Missouri
Department of Transportation
P.O. Box 270
Jefferson City, MO 65102

Brent Trautman, Physical Laboratory
Director

MONTANA

Matt Strizich, Materials Engineer,
Montana Department of Transportation
2701 Prospect Avenue
Helena, MT 59620-1001

Ross O. Metcalfe, Testing Operations
Engineer

NEBRASKA

Mick Syslo, Materials and Research
Engineer, Nebraska Department
of Roads
P.O. Box 94759
Lincoln, NE 68509

NEVADA

Reid Kaiser, Chief Materials Engineer,
Nevada Department of Transportation
1263 S. Stewart Street
Carson City, NV 89712

Pan Changlin, Principal Materials
Engineer

NEW HAMPSHIRE

Alan D. Rawson, Administrator,
Bureau of Materials and Research,
New Hampshire Department
of Transportation
P.O. Box 483-5, Hazen Drive
Concord, NH 03302-0483

NEW JERSEY

Eileen Sheehy, Chief, Bureau
of Materials, New Jersey
Department of Transportation
P.O. Box 607
Trenton, NJ 08625-0607

NEW MEXICO

Bryce Simons, Materials Testing,
Engineer, New Mexico Department
of Transportation
P.O. Box 1149
Santa Fe, NM 87504-1149

NEW YORK

Robert A. Burnett, Director,
Geotechnical Engineering Bureau,
New York State Department of
Transportation
50 Wolf Road
Albany, NY 12232

Donald A. Streeter, Concrete Section
Program Manager

NORTH CAROLINA

Christopher A. Peoples, State Materials
and Test Engineer, North Carolina
Department of Transportation
1801 Blue Ridge Road
Raleigh, NC 27607

Jack E. Cowser, State Materials
Quality Engineer

NORTH DAKOTA

Ron Horner, Materials and Research
Engineer, North Dakota Department
of Transportation
300 Airport Road
Bismarck, ND 58504

OHIO

Lisa Zigmund, Administrator, Office of
Materials Management, Ohio
Department of Transportation
1600 W. Broad Street
Columbus, OH 43223

OKLAHOMA

Reynolds H. Toney, Materials
Engineer, Oklahoma Department
of Transportation
200 N.E. 21st Street
Oklahoma City, OK 73105-3299

Scott Seiter, Assistant Materials
Engineer

OREGON

Cole F. Mullis, Construction Quality
Assurance Engineer, Oregon
Department of Transportation
800 Airport Road, S.E.
Salem, OR 97301

PENNSYLVANIA

Robert D. Horwhat, Chief Materials
Engineer, Pennsylvania Department
of Transportation
81 Lab Lane
Harrisburg, PA 17110

PUERTO RICO

Orlando Diaz Quirindongo, Director,
Materials Testing Lab, Puerto Rico
Department of Transportation and
Public Works, Puerto Rico Highway
and Transportation Authority
P.O. Box 42007
San Juan, PR 00940-2007

RHODE ISLAND

Mark E. Felag, Managing Engineer
(Materials), Rhode Island
Department of Transportation
Two Capitol Hill, Room 370
Providence, RI 02903

Colin A. Franco, Associate Chief
Engineer, Materials and Quality
Assurance

SOUTH CAROLINA

Merrill E. Zwanka, Materials and
Research Engineer, South Carolina
Department of Transportation
P.O. Box 191
Columbia, SC 29202

SOUTH DAKOTA

Joe J. Feller, Chief Materials and
Surfacing Engineer, South Dakota
Department of Transportation
700 E. Broadway Avenue
Pierre, SD 57501-2586

TENNESSEE

Gary Head, Engineering Director,
Division of Materials and Tests,
Tennessee Department
of Transportation
6601 Centennial Boulevard
Nashville, TN 37243-0360

Danny L. Lane, Research and Product
Evaluation

Bill Trolinger, Assistant Materials
Engineer

TEXAS

Darren Hazlett, Director, Materials and
Pavements Section, Construction
Division, Texas Department
of Transportation
125 E. 11th Street
Austin, TX 78701-2483

Caroline Heinen, Section Director,
Materials and Pavements

**U.S. DEPARTMENT OF
TRANSPORTATION**

Jack Springer, Highway Research
Engineer, Federal Highway
Administration, Turner-Fairbank
Highway Research Center, Office
of Infrastructure, Research and
Development, HRDI-13
6300 Georgetown Pike
McLean, VA 22101

**U.S. DEPARTMENT OF
TRANSPORTATION**

Jeffrey Rapol, Federal Aviation
Administration, AAS-100
800 Independence Avenue, S.W.,
Room 616
Washington, DC 20591

UTAH

Scott Andrus, State Materials Engineer,
Utah Department of Transportation
4501 South 2700 West
P.O. Box 145950
Salt Lake City, UT 84114-8290

VERMONT

William Ahearn, Materials and
Research Engineer, Vermont
Agency of Transportation
National Life Building, Drawer 33
Montpelier, VT 05633-5001

VIRGINIA

Charles A. Babish, State Materials
Engineer, Virginia Department
of Transportation
1401 E. Broad Street
Richmond, VA 23219

William R. Bailey, III, Assistant State
Materials Engineer

WASHINGTON

Kurt Williams, Construction Materials
Engineer, Washington Department
of Transportation
P.O. Box 47365
Olympia, WA 98504-7365

Jeff Uhlmeier, State Pavement
Engineer

WEST VIRGINIA

Aaron C. Gillispie, Director, Materials
Control, Soils, and Testing Division,
West Virginia Department
of Transportation
190 Dry Branch Road
Charleston, WV 25306

WISCONSIN

Steven W. Krebs, Chief Materials
Management Engineer, Wisconsin
Department of Transportation
3502 Kinsman Boulevard
Madison, WI 53704

WYOMING

Greg Milburn, State Materials
Engineer, Wyoming Department
of Transportation
5300 Bishop Boulevard
Cheyenne, WY 82009

**ASSOCIATE MEMBERS—
INTERNATIONAL****KOREA**

Jung Hoon, Executive Vice President,
Korea Highway Corporation
293-1 Kumto-Dong, Songnam-Si
Kyonggi-Do, Korea
Seoul, Korea Postal Code 461-380

NEW BRUNSWICK

Carol MacQuarrie, Assistant Director,
Design Branch,
New Brunswick Department
of Transportation
P.O. Box 6000, Kings Place
Fredericton, NB, Canada E3B 5H1

NORTHWEST TERRITORIES

Peter Vician, Deputy Minister of
Transportation, Northwest Territories
Department of Transportation
4150 Franklin Avenue
P.O. Box 1320
Yellowknife, NT,
Canada X1A 2L9

NOVA SCOTIA

Tom Gouthro, Manager of
Technical Services, Nova Scotia
Department of Transportation and
Infrastructure Renewal
107 Guyseorough Road
Fall River, NS, Canada B2T 1J6

ONTARIO

Becca Lane, Manager, Materials
Engineering and Research Office,
Ministry of Transportation
1201 Wilson Avenue, Room 233,
Building "C"
Toronto, ON, Canada M3M 1J8

**ASSOCIATE MEMBERS—
INTERNATIONAL (continued)**

SASKATCHEWAN

Magdy Beshara, Engineering Standards
Branch, Materials and Testing,
Saskatchewan Ministry of Highways
and Infrastructure
1610 Park Street
Regina, SK, Canada S4N 2G1

**ASSOCIATE MEMBERS—
BRIDGE, PORT, AND TOLL**

MASSACHUSETTS

**METROPOLITAN DISTRICT
COMMISSION**

Terrence Johnston, Director of
Laboratory, Massachusetts
Metropolitan District Commission
148 Newton Street
Waltham, MA 02183

**NEW JERSEY TURNPIKE
AUTHORITY**

Sean M. Hill, Senior Project Engineer,
New Jersey Turnpike Authority
P.O. Box 1121
New Brunswick, NJ 08903

**THE PORT AUTHORITY OF
NEW YORK AND NEW JERSEY**

Casimir Bognacki, General Manager,
Material Engineering Division,
The Port Authority of New York
and New Jersey
241 Erie Street
Jersey City, NJ 07310

**ASSOCIATE MEMBERS—
FEDERAL**

USDA FOREST SERVICE

James E. Demby, Jr., Chief
Geotechnical and Dams Engineer,
USDA Forest Service
1601 North Kent Street, Room 500
Arlington, VA 22209

**ASSOCIATE MEMBERS—
OTHER**

TRB

Dr. Amir N. Hanna, Senior
Program Officer, TRB, NCHRP
500 Fifth Street, N.W.
Washington, DC 20001

**ASSOCIATE MEMBERS—
OTHER (continued)**

Ann M. Brach, Director of SHRP2

Frederick D. Hejl, Engineer of
Materials and Construction

Jerry A. DiMaggio, Senior Program
Officer, SHRP2/TRB

Monica A. Starnes, Senior Program
Officer, SHRP2/TRB

AASHTO

Evan Rothblatt, Associate Program
Manager, Materials, AASHTO

Greta Smith, Associate Program
Director, Project Delivery, AASHTO

Steve Lenker, Director of the
Construction Materials Reference Labs
(AMRL/CCRL)

Robert Lutz, Manager, AMRL

AASHTO PROVISIONAL STANDARDS

This is the eighteenth edition of the *AASHTO Provisional Standards*. The publication includes a complete set of current protocols containing a total of 66 Provisional Standards. A chronology of the year-to-year status of the Provisional Standards during the past eight years is included immediately following the Table of Contents. A complete chronology is available on our website at http://downloads.transportation.org/chronological_summary.pdf.

All Provisional Standards are approved for publication by the AASHTO Highway Subcommittee on Materials. The format for the Provisional Standards was developed by AASHTO in 1993, with an objective of providing a mechanism for early distribution of materials specifications and test methods resulting from SHRP and other research. Provisional Standards are standards which have been adopted by the Highway Subcommittee on Materials on a temporary basis for a maximum of eight years. At any time during the eight-year period, the Subcommittee can ballot to convert a Provisional Standard into a Full Standard.

A Provisional Standard is initially approved for two years by a vote of the Subcommittee. At the end of two years and four years after the initial approval, the Technical Section of the Subcommittee responsible for the Provisional Standard can extend its life by a voice vote or letter ballot for an additional two years. At the end of six years and seven years after the initial approval, the Subcommittee can extend the Provisional Standard's life by a voice vote or letter ballot for an additional one year. If a Provisional Standard fails any extension vote, it is discontinued. At the end of eight years, the Subcommittee can ballot a Provisional Standard for adoption as a Full Standard or the Provisional Standard is discontinued.

The time period used to maintain the provisional status is used for the refinement of these standards on the basis of the comments received from the users and other reviewers. It is planned that the Provisional Standards contained herein will be considered by the Highway Subcommittee on Materials for inclusion in future editions of the *Standard Specifications for Transportation Materials and Methods of Sampling and Testing*, either as "Provisional Standards" or possibly as "Full Standards" as presented or in amended form, if the Subcommittee so decides in its balloting.

The Subcommittee, so far, has converted 83 Provisional Standards into Full Standards. These Standards are now regularly published in AASHTO's *Standard Specifications for Transportation Materials and Methods of Sampling and Testing*. At the same time, over a period of 20 years, 40 Provisional Standards did not receive the Subcommittee's approval. These standards, therefore, are excluded from this publication.

Future editions of *AASHTO Provisional Standards* will be published and released, as necessary.

In keeping with the concept of *AASHTO Provisional Standards*, comments on the Provisional Standards included in this edition are welcome and should be directed to AASHTO at the address stated below.

American Association of State
Highway and Transportation Officials
444 North Capitol Street, NW, Suite 249
Washington, DC 20001
www.transportation.org

AASHTO PROVISIONAL STANDARDS

Table of Contents

SUBJECT SEQUENCE

Number	Subject	Page
—	Chronological Summary.....	xix
AGGREGATES		
MP 16-13	Reclaimed Concrete Aggregate for Use as Coarse Aggregate in Hydraulic Cement Concrete	MP 16-1
PP 64-11 (2013)	Determining Aggregate Source Shape Values from Digital Image Analysis Shape Properties	PP 64-1
PP 65-11	Determining the Reactivity of Concrete Aggregates and Selecting Appropriate Measures for Preventing Deleterious Expansion in New Concrete Construction	PP 65-1
TP 77-14	Specific Gravity and Absorption of Aggregate by Volumetric Immersion Method.....	TP 77-1
TP 81-12	Determining Aggregate Shape Properties by Means of Digital Image Analysis	TP 81-1
TP 110-14	Potential Alkali Reactivity of Aggregates and Effectiveness of ASR Mitigation Measures (Miniature Concrete Prism Test, MCPT)	TP 110-1
BITUMINOUS MATERIALS		
MP 23-14	Reclaimed Asphalt Shingles for Use in Asphalt Mixtures	MP 23-1
PP 60-14	Preparation of Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC)	PP 60-1
PP 61-13	Developing Dynamic Modulus Master Curves for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT).....	PP 61-1
PP 66-13	Determination of Long-Term Strength for Geosynthetic Reinforcement.....	PP 66-1
PP 71-11 (2013)	Certifying Suppliers of Emulsified Asphalt	PP 71-1
PP 72-11 (2013)	Recovering Residue from Emulsified Asphalt Using Low-Temperature Evaporative Techniques	PP 72-1
PP 76-13	Troubleshooting Asphalt Specimen Volumetric Differences between Superpave Gyratory Compactors (SCGs) Used in the Design and the Field Management of Superpave Mixtures.....	PP 76-1
PP 77-14	Materials Selection and Mixture Design of Permeable Friction Courses (PFCs).....	PP 77-1
PP 78-14	Design Considerations When Using Reclaimed Asphalt Shingles (RAS) in Asphalt Mixtures	PP 78-1
TP 72-08 (2013)	Quantitative Determination of the Percentage of Lime in Hot Mix Asphalt (HMA)	TP 72-1
TP 91-11	Determining Asphalt Binder Bond Strength by Means of the Asphalt Bond Strength (ABS) Test	TP 91-1
TP 78-09 (2013)	Detecting the Presence of Phosphorous in Asphalt Binder	TP 78-1

Number	Subject	Page
TP 79-13	Determining the Dynamic Modulus and Flow Number for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT).....	TP 79-1
TP 82-10 (2012)	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Water Displacement Measured by Pressure Sensor	TP 82-1
TP 85-10 (2013)	Apparent Viscosity of Hot-Poured Bituminous Crack Sealant Using Brookfield Rotational Viscometer RV Series Instrument	TP 85-1
TP 86-10 (2013)	Accelerated Aging of Bituminous Sealants and Fillers with a Vacuum Oven	TP 86-1
TP 87-10 (2013)	Measure Low-Temperature Flexural Creep Stiffness of Bituminous Sealants and Fillers by Bending Beam Rheometer (BBR)	TP 87-1
TP 88-10 (2013)	Evaluation of the Low-Temperature Tensile Property of Bituminous Sealants by Direct Tension Test	TP 88-1
TP 89-10 (2013)	Measuring Adhesion of Hot-Poured Crack Sealant Using Direct Adhesion Tester	TP 89-1
TP 90-10 (2013)	Measuring Interfacial Fracture Energy of Hot-Poured Crack Sealant Using a Blister Test	TP 90-1
TP 92-14	Determining the Cracking Temperature of Asphalt Binder Using the Asphalt Binder Cracking Device (ABCD)	TP 92-1
TP 101-12	Estimating Fatigue Resistance of Asphalt Binders Using the Linear Amplitude Sweep	TP 101-1
TP 102-12	Evaluation of Asphalt Release Agents	TP 102-1
TP 105-13	Determining the Fracture Energy of Asphalt Mixtures Using the Semicircular Bend Geometry (SCB)	TP 105-1
TP 107-14	Determining the Damage Characteristic Curve of Asphalt Mixtures from Direct Tension Cyclic Fatigue Tests	TP 107-1
TP 108-14	Abrasion Loss of Asphalt Mixture Specimens	TP 108-1

BOX CULVERT, CULVERT PIPE, AND DRAIN TILE

MP 20-13 (2014)	Steel-Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.....	MP 20-1
MP 22-13	Fiber-Reinforced Polymer Composite Materials for Highway and Bridge Structures	MP 22-1
PP 63-09 (2014)	Pipe Joint Selection for Highway Culvert and Storm Drains	PP 63-1

CONCRETE

PP 54-06	Match Curing of Concrete Test Specimens	PP 54-1
PP 58-12	Static Segregation of Hardened Self-Consolidating Concrete (SCC) Cylinders	PP 58-1
TP 59-00 (2007)	Determining Air Content of Hardened Portland Cement Concrete by High-Pressure Air Meter	TP 59-1
TP 64-03 (2007)	Predicting Chloride Penetration of Hydraulic Cement Concrete by the Rapid Migration Procedure.....	TP 64-1
TP 95-14	Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration.....	TP 95-1

Number	Subject	Page
TP 109-14	Nonlinear Impact Resonance Acoustic Spectroscopy (NIRAS) for Concrete Specimens with Damage from Alkali-Silica Reaction (ASR).....	TP 109-1
METALLIC MATERIALS AND COATINGS FOR BRIDGES		
MP 12-04 (2013)	Detectable Warning Surfaces	MP 12-1
MP 18M/ MP 18-09 (2013)	Uncoated, Corrosion-Resistant, Deformed and Plain Alloy, Billet-Steel Bars for Concrete Reinforcement and Dowels	MP 18M/ MP 18-1
TP 84-11 (2014)	Evaluation of Adhesive Anchors in Concrete Under Sustained Loading Conditions	TP 84-1
MISCELLANEOUS		
PP 80-14	Continuous Thermal Profile of Asphalt Mixture Construction	PP 80-1
PP 81-14	Intelligent Compaction Technology for Embankment and Asphalt Pavement Applications	PP 81-1
TP 96-13	Protective Sealers for Portland Cement Concrete	TP 96-1
TP 103-13	Detectable Warning Systems.....	TP 103-1
PAINTING AND TRAFFIC MARKING AND SIGNING		
MP 24-14	Waterborne White and Yellow Traffic Paints	MP 24-1
PP 74-13	Determination of Size and Roundness of Glass Beads Used in Traffic Markings by Means of Computerized Optical Method	PP 74-1
TP 106-13	Determination of Heavy Metal Content of Glass Beads Using X-Ray Fluorescence (XRF)	TP 106-1
TP 111-14	Measuring Retroreflectivity of Pavement Marking Materials Using a Mobile Retroreflectivity Unit	TP 111-1
PAVEMENT STRUCTURES		
PP 67-14	Quantifying Cracks in Asphalt Pavement Surfaces from Collected Images Utilizing Automated Methods	PP 67-1
PP 68-14	Collecting Images of Pavement Surfaces for Distress Detection	PP 68-1
PP 69-14	Determining Pavement Deformation Parameters and Cross Slope from Collected Transverse Profiles	PP 69-1
PP 70-14	Collecting the Transverse Pavement Profile	PP 70-1
TP 76-13	Measurement of Tire/Pavement Noise Using the On-Board Sound Intensity (OBSI) Method.....	TP 76-1
PAVEMENT SURFACE CHARACTERISTICS		
PP 79-14	High-Friction Surface Treatment for Asphalt and Concrete Pavements	PP 79-1
TP 98-13	Determining the Influence of Road Surfaces on Vehicle Noise Using the Statistical Isolated Pass-By Method (SIP)	TP 98-1

Number	Subject	Page
TP 99-13	Determining the Influence of Road Surfaces on Traffic Noise Using the Continuous-Flow Traffic Time-Integrated Method (CTIM).....	TP 99-1

QUALITY ASSURANCE

PP 73-13	Quality Assurance, Job Site Quality Control, and Reapplication of Protective Sealers for Portland Cement Concrete	PP 73-1
----------	---	---------

SOILS

PP 59-09 (2013)	Coal Combustion Fly Ash for Embankments.....	PP 59-1
PP 75-13	Vacuum Drying Compacted Asphalt Specimens	PP 75-1
TP 100-12	Deep Foundation Elements for Bi-Directional Static Axial Compressive Load	TP 100-1
TP 104-13	Rapid Axial Compressive Load Testing of Deep Foundation Units	TP 104-1
TP 112-14	Determining In-Place Density and Moisture Content of Soil and Soil-Aggregate Using Complex Impedance Methodology	TP 112-1

AASHTO PROVISIONAL STANDARDS

Table of Contents

NUMERICAL SEQUENCE

Number	Title	Page
—	Chronological Summary.....	xix
MP 12-04 (2013)	Detectable Warning Surfaces	MP 12-1
MP 16-13	Reclaimed Concrete Aggregate for Use as Coarse Aggregate in Hydraulic Cement Concrete	MP 16-1
MP 18M/ MP 18-09 (2013)	Uncoated, Corrosion-Resistant, Deformed and Plain Alloy, Billet-Steel Bars for Concrete Reinforcement and Dowels	MP 18M/ MP 18-1
MP 20-13 (2014)	Steel-Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 1500-mm (12- to 60-in.) Diameter	MP 20-1
MP 22-13	Fiber-Reinforced Polymer Composite Materials for Highway and Bridge Structures	MP 22-1
MP 23-14	Reclaimed Asphalt Shingles for Use in Asphalt Mixtures	MP 23-1
MP 24-14	Waterborne White and Yellow Traffic Paints	MP 24-1
PP 54-06	Match Curing of Concrete Test Specimens	PP 54-1
PP 58-12	Static Segregation of Hardened Self-Consolidating Concrete (SCC) Cylinders	PP 58-1
PP 59-09 (2013)	Coal Combustion Fly Ash for Embankments	PP 59-1
PP 60-14	Preparation of Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC)	PP 60-1
PP 61-13	Developing Dynamic Modulus Master Curves for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT).....	PP 61-1
PP 63-09 (2014)	Pipe Joint Selection for Highway Culvert and Storm Drains	PP 63-1
PP 64-11 (2013)	Determining Aggregate Source Shape Values from Digital Image Analysis Shape Properties	PP 64-1
PP 65-11	Determining the Reactivity of Concrete Aggregates and Selecting Appropriate Measures for Preventing Deleterious Expansion in New Concrete Construction	PP 65-1
PP 66-13	Determination of Long-Term Strength for Geosynthetic Reinforcement.....	PP 66-1
PP 67-14	Quantifying Cracks in Asphalt Pavement Surfaces from Collected Images Utilizing Automated Methods	PP 67-1
PP 68-14	Collecting Images of Pavement Surfaces for Distress Detection	PP 68-1
PP 69-14	Determining Pavement Deformation Parameters and Cross Slope from Collected Transverse Profiles	PP 69-1
PP 70-14	Collecting the Transverse Pavement Profile.....	PP 70-1
PP 71-11 (2013)	Certifying Suppliers of Emulsified Asphalt	PP 71-1
PP 72-11 (2013)	Recovering Residue from Emulsified Asphalt Using Low-Temperature Evaporative Techniques	PP 72-1

Number	Title	Page
PP 73-13	Quality Assurance, Job Site Quality Control, and Reapplication of Protective Sealers for Portland Cement Concrete	PP 73-1
PP 74-13	Determination of Size and Roundness of Glass Beads Used in Traffic Markings by Means of Computerized Optical Method	PP 74-1
PP 75-13	Vacuum Drying Compacted Asphalt Specimens	PP 75-1
PP 76-13	Troubleshooting Asphalt Specimen Volumetric Differences between Superpave Gyratory Compactors (SCGs) Used in the Design and the Field Management of Superpave Mixtures.....	PP 76-1
PP 77-14	Materials Selection and Mixture Design of Permeable Friction Courses (PFCs).....	PP 77-1
PP 78-14	Design Considerations When Using Reclaimed Asphalt Shingles (RAS) in Asphalt Mixtures	PP 78-1
PP 79-14	High-Friction Surface Treatment for Asphalt and Concrete Pavements	PP 79-1
PP 80-14	Continuous Thermal Profile of Asphalt Mixture Construction	PP 80-1
PP 81-14	Intelligent Compaction Technology for Embankment and Asphalt Pavement Applications	PP 81-1
TP 59-00 (2007)	Determining Air Content of Hardened Portland Cement Concrete by High-Pressure Air Meter	TP 59-1
TP 64-03 (2007)	Predicting Chloride Penetration of Hydraulic Cement Concrete by the Rapid Migration Procedure.....	TP 64-1
TP 72-08 (2013)	Quantitative Determination of the Percentage of Lime in Hot Mix Asphalt (HMA)	TP 72-1
TP 76-13	Measurement of Tire/Pavement Noise Using the On-Board Sound Intensity (OBSI) Method.....	TP 76-1
TP 77-14	Specific Gravity and Absorption of Aggregate by Volumetric Immersion Method.....	TP 77-1
TP 78-09 (2013)	Detecting the Presence of Phosphorous in Asphalt Binder	TP 78-1
TP 79-13	Determining the Dynamic Modulus and Flow Number for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT).....	TP 79-1
TP 81-12	Determining Aggregate Shape Properties by Means of Digital Image Analysis.....	TP 81-1
TP 82-10 (2012)	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Water Displacement Measured by Pressure Sensor	TP 82-1
TP 84-11 (2014)	Evaluation of Adhesive Anchors in Concrete Under Sustained Loading Conditions	TP 84-1
TP 85-10 (2013)	Apparent Viscosity of Hot-Poured Bituminous Crack Sealant Using Brookfield Rotational Viscometer RV Series Instrument.....	TP 85-1
TP 86-10 (2013)	Accelerated Aging of Bituminous Sealants and Fillers with a Vacuum Oven	TP 86-1
TP 87-10 (2013)	Measure Low-Temperature Flexural Creep Stiffness of Bituminous Sealants and Fillers by Bending Beam Rheometer (BBR)	TP 87-1
TP 88-10 (2013)	Evaluation of the Low-Temperature Tensile Property of Bituminous Sealants by Direct Tension Test	TP 88-1
TP 89-10 (2013)	Measuring Adhesion of Hot-Poured Crack Sealant Using Direct Adhesion Tester	TP 89-1
TP 90-10 (2013)	Measuring Interfacial Fracture Energy of Hot-Poured Crack Sealant Using a Blister Test	TP 90-1

Number	Title	Page
TP 91-11	Determining Asphalt Binder Bond Strength by Means of the Asphalt Bond Strength (ABS) Test.....	TP 91-1
TP 92-14	Determining the Cracking Temperature of Asphalt Binder Using the Asphalt Binder Cracking Device (ABCD)	TP 92-1
TP 95-14	Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration.....	TP 95-1
TP 96-13	Protective Sealers for Portland Cement Concrete	TP 96-1
TP 98-13	Determining the Influence of Road Surfaces on Vehicle Noise Using the Statistical Isolated Pass-By Method (SIP)	TP 98-1
TP 99-13	Determining the Influence of Road Surfaces on Traffic Noise Using the Continuous-Flow Traffic Time-Integrated Method (CTIM).....	TP 99-1
TP 100-12	Deep Foundation Elements for Bi-Directional Static Axial Compressive Load	TP 100-1
TP 101-12	Estimating Fatigue Resistance of Asphalt Binders Using the Linear Amplitude Sweep	TP 101-1
TP 102-12	Evaluation of Asphalt Release Agents	TP 102-1
TP 103-13	Detectable Warning Systems.....	TP 103-1
TP 104-13	Rapid Axial Compressive Load Testing of Deep Foundation Units	TP 104-1
TP 105-13	Determining the Fracture Energy of Asphalt Mixtures Using the Semicircular Bend Geometry (SCB).....	TP 105-1
TP 106-13	Determination of Heavy Metal Content of Glass Beads Using X-Ray Fluorescence (XRF)	TP 106-1
TP 107-14	Determining the Damage Characteristic Curve of Asphalt Mixtures from Direct Tension Cyclic Fatigue Tests	TP 107-1
TP 108-14	Abrasion Loss of Asphalt Mixture Specimens	TP 108-1
TP 109-14	Nonlinear Impact Resonance Acoustic Spectroscopy (NIRAS) for Concrete Specimens with Damage from Alkali-Silica Reaction (ASR).....	TP 109-1
TP 110-14	Potential Alkali Reactivity of Aggregates and Effectiveness of ASR Mitigation Measures (Miniature Concrete Prism Test, MCPT)	TP 110-1
TP 111-14	Measuring Retroreflectivity of Pavement Marking Materials Using a Mobile Retroreflectivity Unit	TP 111-1
TP 112-14	Determining In-Place Density and Moisture Content of Soil and Soil-Aggregate Using Complex Impedance Methodology	TP 112-1

AASHTO PROVISIONAL STANDARDS
CHRONOLOGICAL SUMMARY

Prov Std.	Brief Title	Tech. Sec.	Ballot 01/07	Pub 07/07	Ballot 12/07	Pub 06/08	Ballot 01/09	Pub 06/09	Ballot 02/10	Pub 06/10	Ballot 08/10	Pub 06/11	Ballot 08/11	Pub 06/12	Ballot 08/12	Pub 06/13	Ballot 08/13	Pub 06/14	Remarks
MP 1	PG Binders	2b																	Full Std
MP 1a	PG Mod. Bndr. Crit. Lowtemp	2b																	Full Std
MP 2	Spec. Superpave Mix	2d																	Full Std
MP 5	Decks - Cathod. Protect.	4g																	Delete
MP 6	PE Pipe 1050 & 1200 mm	4b																	Full Std
MP 7	PE Pipe 1350 & 1500 mm	4b																	Full Std
MP 8	SMA	2d	✓	✓	✓	M 325													Full Std
MP 9	Compost Filter Berms	1a		✓	Reconf.	✓		✓	✓	R 51									Full Std
MP 10	Compost Blankets	1a		✓	Reconf.	✓		✓	✓	R 52									Full Std
MP 11	Inertial Profiler	5a	✓	✓	✓	✓		✓	✓	M 328									Full Std
MP 12	Detectable Warning Surface	4d		✓		✓		✓		✓		✓		✓	✓	✓	✓	✓	Extended
MP 13	Stainless Clad Rebar	4g	Reconf.	✓		✓		✓		✓	✓	M 329							Full Std
MP 14	WIM Pavement Smoothness	5a		✓	✓	✓		✓		✓		✓	✓	✓	✓	M 331			Full Std
MP 15	Reclaimed Asphalt Shingles	2d		✓		✓	✓	✓		✓		✓		✓	✓	✓			Delete
MP 16	RCA Used in Portland Cement	1c	✓	✓		✓		✓	✓	✓		✓		✓	✓	✓		✓	
MP 17	Pavement Ride Quality	5a	✓	PP 51	✓	✓	Reconf.	✓	✓	R 54									Full Std
MP 18	Uncoated Billet-Steel Rebar	4g					✓	✓	✓	✓	Reconf.	✓		✓	✓	✓	Reconf.	✓	
MP 19	PG Asphalt Binder Using MSCR	2b							✓	✓	✓	✓		✓	✓	✓	✓	M 332	Full Std
MP 20	Steel-Reinforced PE, 12–36 in.	4b							✓	✓	✓	✓		✓	✓	✓	Reconf.	✓	
MP 21	PP Pipe, 330- to 1500-mm diam.	4b									✓	✓		✓	✓	M 330			Full Std
MP 22	Fiber-Reinforced Polymer Comp.	4f													✓	✓		✓	
MP 23	Reclaimed Asphalt Shingles	2d															✓	✓	New
MP 24	Waterborne Traffic Paints	4c															✓	✓	New
PP 1	PAV Aging	2b																	Full Std
PP 2	Aging Long/Short Term	2d																	Full Std
PP 3	Rolling Wheel Comp.	2d																	Delete
PP 5	Eval. Modf. Asph. System	2d																	Delete

xx

Prov Std.	Brief Title	Tech. Sec.	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Remarks
			01/07	07/07	12/07	06/08	01/09	06/09	02/10	06/10	08/10	06/11	08/11	06/12	08/12	06/13	08/13	06/14	
PP 6	PG Binders Verification	2b																	Full Std
PP 7	Def. Calib. Load Cells FWD	5a																	Full Std
PP 8	Ref. Calib. Load Cells FWD	5a																	Full Std
PP 10	Test Pits Eval. Pavt. Perf.	1b																	Delete
PP 19	Vol. Design HMA	2d																	Delete
PP 20	Crack Sealant Pavement	5a																	Delete
PP 21	Eval. Cold Mixes	2a																	Delete
PP 22	Spec. Crack Sealants	2a																	Delete
PP 23	Cond. of Bridges Eval.	3c																	Delete
PP 25	Joint Seals in Conc. Pave.	3c																	Delete
PP 26	Certif. Binder Suppliers	2b																	Full Std
PP 28	Design Superpav. Mix	2d																	Full Std
PP 29	Deicing Chem. Eval.	5b																	Full Std
PP 30	Coatings Zinc Primer	4c																	Full Std
PP 31	Profile Rod/Level Pave.	5a																	Full Std
PP 32	Profile Dipstick Pave.	5a																	Full Std
PP 33	Boring Hole Decomm.	5b																	Full Std
PP 34	Crack Tendency Conc.	3c		✓	✓	T 334													Full Std
PP 35	Eval. Gyr. Compactors	2d	✓																Delete
PP 36	Steel Pile Corr.	1a																	Full Std
PP 37	Roughness Pavmnts	5a	✓	/R 43															Combined
PP 37M	Roughness Pavmnts (Metric)	5a	✓	R 43M/															Full Std
PP 38	Rut Depth Measurmnts	5a	✓	✓	✓	R 48													Full Std
PP 39	Faultng Conc. Pavts.	5a																	Full Std
PP 40	Ground Pen. Radar	5a																	Full Std
PP 41	SMA	2d	✓	✓	✓	R 46													Full Std
PP 42	Low Temp Props-Binders	2b	✓	✓		✓		R 49											Full Std
PP 44	Cracks AC Pavmts	5a		✓	✓	✓	✓	✓	✓	R 55									Full Std

Prov Std.	Brief Title	Tech. Sec.	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Remarks
			01/07	07/07	12/07	06/08	01/09	06/09	02/10	06/10	08/10	06/11	08/11	06/12	08/12	06/13	08/13	06/14	
PP 45	Qualif. Rebar mills	4g	✓	✓		✓		✓	✓	R 53									Full Std
PP 46	Geo. Reinf. Bases AC Pavt	4e		✓	✓	✓	✓	R 50											Full Std
PP 47	Comparing 2 Gyratories	2d																	Delete
PP 48	Gyratory Internal Angle	2d		✓		✓	✓												Delete
PP 49	Cert. Inertial Profilers	5a	✓	✓	✓	✓	✓	✓	✓	R 56									Full Std
PP 50	Operating Inertial Profilers	5a	✓	✓		✓	✓	✓	✓	R 57									Full Std
PP 51	Pavement Ride Quality	5a	✓	MP 17	✓	✓	Reconf.	✓	✓	R 54									Full Std
PP 52	Develop QA Plan for HMA	5c					✓												Full Std
PP 53	Reclaimed Asphalt Shingles	2d		✓		✓	✓	✓		✓		✓	✓	✓	✓	✓			Delete
PP 54	Match Curing of Concrete	3c		✓		✓		✓		✓		✓	✓	✓	✓	✓		✓	Extended
PP 55	Overcoating Field Test Program	4c		✓		✓		✓		✓		✓	Reconf.	✓	✓				Delete
PP 56	Suitability of Recyled Materials	5b	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	R 65	Full Std
PP 57	Equipment Calibration	5c		✓	✓	✓		✓	✓	✓		✓	✓	R 61					Full Std
PP 58	Static Segr. of SCC Cylinders	3c			✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	
PP 59	Coal Fly Ash for Embankments	1a					✓	✓	✓	✓		✓	✓	✓	✓	✓	Reconf.	✓	
PP 60	Cyl. Performance Tests/SGC	2d					✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	Revised
PP 61	Dyn. Mod. Master Curves/AMPT	2d					✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	
PP 62	Dyn. Mod. Master Curves/HMA	2d					✓	✓	✓	✓		✓		✓	✓	R 62			Full Std
PP 63	Pipe Joint Selection	4b					✓	✓	✓	✓	Reconf.	✓		✓	✓	✓	Reconf.	✓	
PP 64	Agg Shape from DI Analysis	1b							✓	✓	✓	✓		✓	✓	✓	✓	✓	Extended
PP 65	Reactivity of Concr. Agg. & Exp.	3c							✓	✓	✓	✓		✓		✓		✓	
PP 66	Long-Term Strength Geo Reinf	4e							✓	✓		✓		✓	✓	✓		✓	
PP 67	Quant. Cracks in Asphalt Surf	5a							✓	✓		✓		✓	✓	✓	✓	✓	Revised
PP 68	Collect Images for Distress Det	5a							✓	✓		✓		✓	✓	✓	✓	✓	Revised
PP 69	Pave. Deformation Parameters	5a							✓	✓		✓		✓	✓	✓	✓	✓	Revised
PP 70	Transverse Pavement Profile	5a							✓	✓		✓		✓	✓	✓	✓	✓	Revised
PP 71	Suppliers of Emulsified Asphalt	2a									✓	✓		✓	✓	✓	Reconf.	✓	
PP 72	Residue from Emulsified Asphalt	2a									✓	✓		✓	✓	✓	Reconf.	✓	

Prov Std.	Brief Title	Tech. Sec.	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Remarks
			01/07	07/07	12/07	06/08	01/09	06/09	02/10	06/10	08/10	06/11	08/11	06/12	08/12	06/13	08/13	06/14	
PP 73	Sealers Port. Cem. Concrete	4c									✓	✓		✓	✓	✓		✓	
PP 74	Glass Beads Traff. Mark.	4c									✓	✓	✓	✓	✓	✓		✓	
PP 75	Vacuum Drying Comp. Asphalt	2c													✓	✓		✓	
PP 76	Troubleshooting Ashp. Specim.	2d													✓	✓		✓	
PP 77	PFC Mix Design	2d															✓	✓	New
PP 78	Reclaimed Asphalt Shingles	2d															✓	✓	New
PP 79	High-Frict. Surface Treatmt.	4c															✓	✓	New
PP 80	Cont. Thermal Profile Asph. Mix.	5c															✓	✓	New
PP 81	Intelligent Compact. Tech. Embk.	5c															✓	✓	New
TP 1	Flex. Creep-Binders-BBR	2b																	Full Std
TP 2	Asphalt Extraction	2c																	Full Std
TP 3	Direct Ten. DT Binders	2b																	Full Std
TP 4	Gyr. Comp. HMA	2d																	Full Std
TP 5	Dynamic Shear-DSR	2b																	Full Std
TP 6	Absorb. & Desorb. Bind.	2b																	Delete
TP 7	Simple Shear SST	2d																	Full Std
TP 8	Fatigue-Beam Flex. HMA	2d																	Full Std
TP 9	Creep-IDT HMA	2d																	Full Std
TP 10	Therm. Stress Restrtn.	2d																	Delete
TP 11	Steel Corr. Rate in Conc.	4g																	Delete
TP 12	Hyd. Fract. C. Agg.	1c																	Delete
TP 14	ASR Mortar Bars	1c																	Full Std
TP 17	Rapid F/T Conc.	3c																	Delete
TP 18	Fund. Travers. Frequen.	3c																	Delete
TP 19	3rd Pt. Load Flex. Conc.	3c																	Delete
TP 20	Comp. Strength Conc.	3c																	Full Std
TP 22	Penet. AC Imped. Conc.	3c																	Delete
TP 23	% Water Micrwav Conc	3c																	Full Std

Prov Std.	Brief Title	Tech. Sec.	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Remarks
			01/07	07/07	12/07	06/08	01/09	06/09	02/10	06/10	08/10	06/11	08/11	06/12	08/12	06/13	08/13	06/14	
TP 24	N. Gage Den. Place Conc.	3c																	Delete
TP 26	Permb. Surf. Airflow	3c																	Delete
TP 28	Voids in Concrete	5a																	Delete
TP 29	Bond St. Old/New Conc.	3c																	Full Std
TP 31	Mr. HMA	2d																	Delete
TP 33	Voids Fine Agg.	1c																	Full Std
TP 34	Moist. Sensy. HMA	2d																	Delete
TP 35	Elect. Resis. Pen. Sealer	3b																	Delete
TP 36	Pulse Radar AC/Decks	3c																	Delete
TP 37	Puls. Veloct. Prefor. Mem.	3c																	Delete
TP 39	Modified Rice SG	2c																	Full Std
TP 40	% Asphalt HMA	2a																	Delete
TP 41	% Asphalt Cold Mix Strip.	2a																	Delete
TP 42	% Asphalt Cold Mix Drain	2a																	Delete
TP 43	Workability Cold Mixes	2a																	Delete
TP 44	Cohesion Cold Mixes	2a																	Delete
TP 46	Mr. Soils & Agg.	1a																	Full Std
TP 47	Ecology-Deicing Chem.	5b																	Delete
TP 48	Brookfld Vis.	2b																	Full Std
TP 50	Pen. Sealr by Water Abs.	3b																	Delete
TP 51	Cath. Systm Tests/Decks	4g																	Delete
TP 52	St. Maturity Test Conc.	3b																	Full Std
TP 53	AC by Ignition Method	2c																	Full Std
TP 54	Cement Paste Stiffness	3a																	Delete
TP 55	Chlorides- Sp. Ion Probe	3c	✓	T 332															Full Std
TP 56	Void Cont. C. Agg.	1c																	Full Std
TP 57	Methy. Blue Value Clays	1c	✓	T 330															Full Std
TP 58	CA Degradation-Deval.	1c																	Full Std

Prov Std.	Brief Title	Tech. Sec.	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Remarks
			01/07	07/07	12/07	06/08	01/09	06/09	02/10	06/10	08/10	06/11	08/11	06/12	08/12	06/13	08/13	06/14	
TP 59	Air Cont. Hardened Conc.	3c	✓	✓	✓	✓		✓		✓		✓		✓	✓	✓		✓	
TP 60	Thermal Expan of Conc.	3c	✓	✓	✓	✓		T 336											Full Std
TP 61	% Fract. Coarse Agg.	1c	Reconf.	✓		✓		T 335											Full Std
TP 62	Dynamic Mod. of HMA	2d	✓	✓		✓		✓	✓	✓	✓	T 342							Full Std
TP 63	Asphalt Pvmt. Analyzer	2d	✓	✓		✓	✓	✓	✓	T 340									Full Std
TP 64	Rapid Chloride Migration	3c	Reconf.	✓	✓	✓		✓		✓		✓		✓	✓	✓		✓	
TP 65	Detection of Metallic Zinc	4c	Reconf.	✓		✓		T 337											Full Std
TP 66	Hindered Amine Lt. Stabs.	4c		✓	✓	✓		T 338											Full Std
TP 67	Isocyanate Content	4c	✓	✓	✓	✓		T 339											Full Std
TP 68	Density by Elect.Surf.Cont.	2c	Reconf.	✓		✓		✓		✓	Reconf.	✓	✓	T 343					Full Std
TP 69	BSG by Vacuum Sealing	2c	✓	T 331															Full Std
TP 70	MSCR Test Using DSR	2b	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	T 350	Full Std
TP 71	SGC Internal Angle—Loading	2d	✓	✓		✓	✓	✓		✓		✓	✓	T 344					Full Std
TP 72	Percentage of Lime in HMA	2c			✓	✓		✓		✓	Reconf.	✓		✓	✓	✓		✓	Extended
TP 73	Slump Flow of SCC	3b			✓	✓	✓	✓		✓		✓		✓	✓	T 347			Full Std
TP 74	Passing Ability SCC by J-Ring	3b			✓	✓	✓	✓		✓		✓		T 345					Full Std
TP 75	AV Charc. Fresh Mixed Conc.	3b			✓	✓		✓		✓		✓		✓	✓	T 348			Full Std
TP 76	Tire/Pave. Noise Using OBSI	5a			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
TP 77	SpGr&Absorption of Agg by VIM	1c					✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	Revised
TP 78	Detect P in Asphalt Binder	2b					✓	✓		✓		✓		✓	✓	✓	Reconf.	✓	
TP 79	Dynamic Modulus and Flow No.	2d					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
TP 80	VSI for SCC	3b					✓	✓	✓	✓		✓		✓	✓	✓	✓	T 351	Full Std
TP 81	Det Agg Shape by DI Analysis	1c							✓	✓	✓	✓	✓	✓		✓		✓	
TP 82	SPGr of Agg by Water Displace.	2c							✓	✓		✓		✓	✓	✓		✓	
TP 83	Fabr. of 2-in. Cubes Using Grout	3b							✓	✓		✓		✓	✓	✓	✓	R 64	Full Std
TP 84	Adh. Anchors/Sustained Load	4c							✓	✓	✓	✓		✓	✓	✓	Reconf.	✓	
TP 85	Visc. of Crack Seal./Brook. RV	4e							✓	✓		✓		✓		✓		✓	Extended
TP 86	Aging Seal/Fillers w/Vac Ov.	4e							✓	✓		✓		✓		✓		✓	Extended

Prov Std.	Brief Title	Tech. Sec.	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Ballot	Pub	Remarks
			01/07	07/07	12/07	06/08	01/09	06/09	02/10	06/10	08/10	06/11	08/11	06/12	08/12	06/13	08/13	06/14	
TP 87	Flex. Creep Stiffness by BBR	4e							✓	✓		✓		✓		✓		✓	Extended
TP 88	Tensile Prop. of Seal. by DTT	4e							✓	✓		✓		✓		✓		✓	Extended
TP 89	Adh of Crack Seal. by DAT	4e							✓	✓		✓		✓		✓		✓	Extended
TP 90	Measuring Inertial Fracture	4e							✓	✓		✓		✓		✓		✓	Extended
TP 91	Binder Bond Strength Test	2a									✓	✓		✓	✓	✓		✓	
TP 92	Cracking Temp. Using ABCD	2b									✓	✓		✓	✓	✓	✓	✓	Revised
TP 93	SSC Frmwk. Press. Transducers	3b									✓	✓	✓	✓	✓	✓	✓	T 352	Full Std
TP 94	SSC Fill Capac. Caisson Test	3b									✓	✓		✓	✓	T 349			Full Std
TP 95	Surf. Resist. Chloride Ion	3c									✓	✓		✓	✓	✓	✓	✓	Revised
TP 96	Prot Sealers Port Cem Concrete	4c									✓	✓		✓	✓	✓		✓	
TP 97	Glass Beads in Pavemt Markgs	4c									✓	✓	✓	T 346					Full Std
TP 98	Rd Surf Veh Noise SIP	5a									✓	✓	✓	✓	✓	✓		✓	
TP 99	Rd Surf Traff Noise CTIM	5a									✓	✓	✓	✓	✓	✓		✓	
TP 100	Deep Foundation Elements	1b											✓	✓		✓		✓	
TP 101	Estimating Fatigue Resistance	2b											✓	✓		✓		✓	
TP 102	Eval. of Asphalt Release Agents	2b											✓	✓		✓		✓	
TP 103	Detectable Warning Systems	4d											✓	✓	✓	✓		✓	
TP 104	Rapid Axial Compressive Load	1b													✓	✓		✓	
TP 105	Determining Fracture Energy	2d													✓	✓		✓	
TP 106	Determin. of Hvy Metal Content	4c													✓	✓		✓	
TP 107	Damage Char. Curve Dir. Tension	2d															✓	✓	New
TP 108	Abrasion Loss Asph. Mixt. Spec.	2d															✓	✓	New
TP 109	NIRAS Concrete w/Damage ASR	3c															✓	✓	New
TP 110	Potential Alkali React. Agg. ASR	3c															✓	✓	New
TP 111	Meas. Retrorefl. Pavemt. Markg.	4c															✓	✓	New
TP 112	Complex Impedance	1b															✓	✓	New

Standard Specification for Detectable Warning Surfaces

AASHTO Designation: MP 12-04 (2013)¹



**American Association of State Highway and Transportation Officials
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001**

Standard Specification for

Detectable Warning Surfaces

AASHTO Designation: MP 12-04 (2013)¹



1. SCOPE

- 1.1. Detectable warnings provide a distinctive surface of truncated domes detectable by cane or underfoot to alert people with vision impairments of the transition to vehicular ways. These warnings compensate for the sloped surfaces of curb ramps that remove a tactile cue provided by curb faces.
- 1.2. It is not the intent of this specification to relieve the supplier from the final responsibility to provide an appropriate product for the intended function, nor is it intended to specify all the design details. The objective is to provide a sufficiently detailed specification such that the function establishes a standard geometry of the detectable warning surface.

2. REFERENCED DOCUMENTS

- 2.1. The Access Board, *Accessibility, Guidelines and Standards*. Revised Draft Guidelines for Accessible Public Rights-of-Way. November 23, 2005. www.access-board.gov/prowac/draft.htm.

3. TERMINOLOGY

- 3.1. *detectable warning*—A surface feature built in or applied to walking surfaces or other elements to warn of hazards on a circulation path.

4. DETECTABLE WARNING SURFACES

- 4.1. *General*—Detectable warnings shall consist of a surface of truncated domes aligned in a square or radial grid pattern and shall comply with the following requirements:
 - 4.1.1. *Dome Size*—Truncated domes in a detectable warning surface shall have a base diameter of 0.9 in. (23 mm) minimum to 1.4 in. (36 mm) maximum, a top diameter of 50 percent of the base diameter minimum to 65 percent of the base diameter maximum, and a height of 0.2 in. (5 mm).
 - 4.1.2. *Dome Spacing*—Truncated domes in a detectable warning surface shall have a center-to-center spacing of 1.6 in. (41 mm) minimum and 2.4 in. (61 mm) maximum, and a base-to-base spacing of 0.65 in. (16 mm) minimum, measured between the most adjacent domes.
 - 4.1.3. *Contrast*—Detectable warning surfaces shall contrast visually with adjacent walking surfaces either light-on-dark or dark-on-light.
 - 4.1.4. *Size*—Detectable warning surfaces shall extend 24 in. (610 mm) minimum in the direction of travel and the full width of the curb ramp, landing, or blended transition.

4.2. *Location:*

- 4.2.1. *Curb Ramps and Blended Transitions*—The detectable warning surface shall be located so that the edge nearest the curb line is 6 in. (150 mm) minimum and 8 in. (205 mm) maximum from the curb line.
- 4.2.2. *Rail Crossings*—The detectable warning surface shall be located so that the edge nearest the rail crossing is 6 in. (150 mm) minimum and 8 in. (205 mm) maximum from the vehicle dynamic envelope.
- 4.2.3. *Platform Edges*—Detectable warning surfaces at platform boarding edges shall be 24 in. (610 mm) wide and shall extend the full length of the platform.

¹ This provisional standard was first published in 2004.

Standard Specification for Reclaimed Concrete Aggregate (RCA) for Use as Coarse Aggregate in Hydraulic Cement Concrete

AASHTO Designation: MP 16-13¹



**American Association of State Highway and Transportation Officials
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001**

Reclaimed Concrete Aggregate (RCA) for Use as Coarse Aggregate in Hydraulic Cement Concrete

AASHTO Designation: MP 16-13¹



1. SCOPE

- 1.1. This specification covers coarse aggregate derived from reclaimed concrete for use in hydraulic cement concrete. The specification is not intended for use when lightweight, high-density, or other specialty concrete applications are required. When aggregate materials are properly processed and manufactured to the requirements of this specification, combined and mixed in accordance with the appropriate requirements, and placed, consolidated, and cured properly, a concrete structure of acceptable strength and durability can be produced. Introducing reclaimed concrete aggregate (RCA) into concrete, however, requires the use of quality control and quality assurance procedures to ensure that deleterious materials that might be present in the reclaimed concrete aggregate will not adversely impact the quality of the concrete product.
- 1.2. Best practice applications for using reclaimed concrete aggregate in concrete shall consist of concrete pavements, cement-treated base courses, sidewalks, median barriers, curbs, and other nonstructural applications.
- Note 1**—Caution should be exercised if reclaimed concrete aggregate is considered for use in structural applications. The presence of deleterious materials and the variability in the source concrete may produce inconstant volumetric properties and affect the properties of the concrete produced. Two properties of concern include dimensional stability and creep.
- 1.3. Because reclaimed concrete aggregate is a recycled material, various state and local jurisdiction laws and regulations may be applicable. The user of this specification is cautioned to contact state and local environmental and other local regulators to determine what requirements are appropriate.

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 43, Sizes of Aggregate for Road and Bridge Construction
 - M 80, Coarse Aggregate for Hydraulic Cement Concrete
 - T 2, Sampling of Aggregates
 - T 11, Materials Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
 - T 19M/T 19, Bulk Density ("Unit Weight") and Voids in Aggregate
 - T 27, Sieve Analysis of Fine and Coarse Aggregates
 - T 85, Specific Gravity and Absorption of Coarse Aggregate
 - T 96, Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

- T 103, Soundness of Aggregates by Freezing and Thawing
- T 104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- T 112, Clay Lumps and Friable Particles in Aggregate
- T 113, Lightweight Pieces in Aggregate
- T 161, Resistance of Concrete to Rapid Freezing and Thawing
- T 260, Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials
- T 303, Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction
- T 327, Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

2.2. *ASTM Standards:*

- C 125, Standard Terminology Relating to Concrete and Concrete Aggregates
- C 227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
- C 289, Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
- C 295, Standard Guide for Petrographic Examination of Aggregates for Concrete
- C 342, Standard Test Method for Potential Volume Change of Cement-Aggregate Combinations (Withdrawn 2001)
- C 586, Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks as Concrete Aggregates (Rock-Cylinder Method)
- C 856, Standard Practice for Petrographic Examination of Hardened Concrete
- C 1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- D 6928, Standard Test Method for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

3. TERMINOLOGY

- 3.1. The definitions of concrete and concrete aggregate terms used in this specification are provided in ASTM C 125. The term “reclaimed concrete aggregate,” as used in this specification, shall mean coarse aggregate material derived from the crushing, processing, and classification of hydraulic cement concrete construction debris recovered from roadways, sidewalks, buildings, bridges, and other sources.

4. ORDERING INFORMATION

- 4.1. The purchaser or specifier shall include the following information in the purchase order or contract documents:
- 4.1.1. Reference to this specification and year of issue,
 - 4.1.2. Grading to be furnished (AASHTO Size No.) (Section 6.1),
 - 4.1.3. Soundness testing requirement (Section 7.2),
 - 4.1.4. Class designation of aggregate (Table 1),

- 4.1.5. Whether the restriction on reactive materials applies (Section 7.3),
- 4.1.6. Additional testing requirements, and
- 4.1.7. Any exceptions or additions to this specification.

5. SAMPLING

- 5.1. Sample reclaimed concrete aggregate in accordance with T 2.

6. GRADING AND PROPORTIONS

- 6.1. Coarse reclaimed concrete aggregate tested in accordance with T 27 shall conform to the coarse aggregate gradation requirements prescribed in M 43 for the size number specified in the contract documents.

Note 2—Generally, there is no reason that reclaimed concrete aggregate should have gradation requirements that differ from natural or conventional aggregate materials.

Note 3—The ranges shown in M 43 are, by necessity, very wide in order to accommodate nationwide conditions. For quality control of any specific operation, a producer should develop an average gradation for the particular source and production facilities, and control the gradation within reasonable tolerances from this average. Where coarse aggregate sizes numbers 357 or 467 are used, the aggregate should be furnished in at least two separate sizes.

7. PHYSICAL PROPERTIES

- 7.1. Reclaimed concrete aggregate shall have a maximum Los Angeles abrasion loss of 50 percent, measured in accordance with T 96.

Note 4—T 327, Micro-Deval, may be required in lieu of T 96 if the specifying agency has experience with the procedure and has established limits.

- 7.2. Reclaimed concrete aggregate soundness testing shall be conducted in accordance with T 104 at 5 cycles. The maximum limit for soundness shall be 12 percent if sodium sulfate is used and 18 percent if magnesium sulfate is used.

Note 5—Reclaimed concrete aggregate can be susceptible to sulfate attack when tested for soundness using sodium sulfate or magnesium sulfate solutions, resulting in higher than expected soundness loss values (particularly when sodium sulfate solution is used in the test procedure). Sulfate solution test methods (T 104) should be applied if local experience has shown these methods to be acceptable; however, alternative approaches may be used.

- 7.3. Reclaimed concrete aggregate for use in concrete that will be subjected to in-service wetting, extended exposure to humid atmosphere, or contact with moist ground shall not contain any materials that are reactive with alkali components in the cement in an amount sufficient to cause excessive expansion of mortar or concrete. Except, if such materials are present in injurious amounts, the coarse aggregate may be used with the addition of a material that has been shown to prevent harmful expansion due to the alkali-aggregate reaction. Alkali reactivity shall be tested in accordance with T 303 when alkali-silica reaction is suspected, and in accordance with ASTM C 586 when alkali-carbonate reaction is suspected.

Note 6—If the source and history of the reclaimed concrete aggregate are known and no reactive failures were present in the source concrete, testing for reactive expansion may not be necessary. However, unless a precise history is known, the source concrete may have not been exposed to all elements required to cause reactive expansion, and the reclaimed concrete aggregate may be reactive. See Appendix X2 for a discussion of alternative test methods. Mitigation methods found

to work with natural reactive aggregates may not be effective with potentially expansive RCA. Aggregate that gave satisfactory performance in the original concrete may not continue to do so when used as RCA in new concrete. Consider the contribution of alkali from the RCA in addition to the alkali from the new hydraulic cement.

- 7.4. Reclaimed concrete aggregate for use in concrete that will be subjected to freeze-thaw action shall not contain aggregate components that expand and result in D-cracking of the concrete. When potential D-cracking is suspected, the reclaimed concrete aggregate shall be tested in accordance with T 161.

Note 7—In areas where D-cracking is a significant problem and agencies have developed equivalent test methods, local methods of testing may be used. Acceptance criteria for T 161 and equivalent methods should be based on local criteria that have been developed to address the issue of D-cracking.

- 7.5. Reclaimed concrete aggregate shall meet the flat and elongated particle requirements of the specifying jurisdiction.

- 7.6. Reclaimed concrete aggregate shall be tested in accordance with T 85 to establish the specific gravity and absorption. For specific gravity, the total variability of tests from minimum value to maximum value shall not exceed 0.100; and for absorption, the total variability of tests from minimum value to maximum value shall not exceed 0.8 percent.

Aggregates that have specific gravity and absorption values that fall outside of these limits shall be stockpiled separately, and the limits stated above shall apply to the new stockpile.

Note 8—Testing of specific gravity and absorption may not be necessary during production of aggregate if the reclaimed concrete is from one source with known aggregate properties.

Note 9—Coarse reclaimed concrete aggregate may contain air-entrained concrete mortar and, therefore, may be highly absorptive and can exhibit low and highly variable specific gravity values. Utilizing highly absorptive aggregates (coarse and fine) that do not exhibit consistent specific gravity values in hydraulic cement concrete can adversely affect the weighing and batching process in the concrete production operation. Further discussions of this issue are presented in Appendix X1.

8. DELETERIOUS SUBSTANCES

- 8.1. Reclaimed concrete aggregate shall not contain clay lumps and friable particles, chert, coal and lignite, or other deleterious substances that exceed the maximum allowable amounts listed in Table 1 when tested in accordance with T 112, T 113, and ASTM C 295.

Table 1—Limits for Deleterious Substances and Physical Property Requirements of Reclaimed Coarse Aggregate for Concrete

Class Designation ^b	Maximum Allowable % ^a				
	Clay Lumps and Friable Particles	Chert (Less Than 2.40 sp gr SSD) ^c	Sum of Clay Lumps, Friable Particles, and Chert (Less Than 2.40 sp gr SSD) ^c	Other Deleterious Substances ^d	Coal and Lignite
A	2.0	3.0	2.0	0.3	0.2
B	3.0	5.0	3.0	0.3	0.2
C	3.0	8.0	5.0	0.3	0.2

^a The engineer may supplement the requirements of Table 1 by placing limits on the amount of deleterious substances or physical properties in accordance with local experience and practice.

^b Aggregate conforming to the requirements for the various classes designated in Table 1 should generally be suitable for the following uses:

Typical Uses (Suggested)	Weathering Exposure	Class of Aggregate
Concrete pavements, cement-treated base courses, sidewalks, median barriers, curbs, and other nonstructural applications	Severe	A
	Moderate	B
	Negligible	C

The purchaser or specifier must indicate the class of aggregate to be furnished as the degree of weathering exposure is not precisely defined.

^c These limitations apply only to aggregate in which chert appears as an impurity. They are not applicable to gravels that are predominantly chert. Limitations on the soundness of such aggregate must be based on service records in the environment in which it is used.

^d Other deleterious substances include adherent fines, vegetable matter, plastics, plaster, paper, gypsum board, metals, fabrics, wood, brick, tile, glass, and bituminous materials. The percentage of these materials shall be determined in accordance with ASTM C 295 or other equivalent method approved by the specifying jurisdiction.

Note 10—The presence of deleterious materials in aggregates used in the production of hydraulic cement concrete could adversely affect concrete setting time, strength, or both, and could also induce expansive reactions that could result in premature deterioration of the concrete structure. As a result, strict quality control and quality assurance procedures are required to ensure that reclaimed concrete aggregate material used as coarse aggregate in the production of concrete will not adversely affect the quality of the concrete product.

- 8.2. Reclaimed concrete aggregate shall not contain more than 1.5 percent by mass of material finer than the 75- μ m (No. 200) sieve in accordance with T 11.
- 8.3. Reclaimed concrete aggregate, when sampled and tested according to T 260, shall not contain chloride ion in excess of 0.6 lb per cubic yard of concrete.

9. QUALITY CONTROL

- 9.1. If the contractor/supplier wishes to use reclaimed concrete aggregate, or combinations of reclaimed concrete aggregate and other approved aggregate materials, a request shall be made to the engineer for approval. The percentage of combined materials shall be established as part of a pre-submitted blended aggregate combination. At the engineer's discretion, revised hydraulic cement concrete mix designs shall be required when percentages of materials change.

Note 11—A revised concrete mix design is recommended when percentages of materials change. The reclaimed concrete aggregate will likely have a different specific gravity and absorption than the virgin aggregate.

- 9.2. The contractor/supplier of recycled concrete aggregate shall develop and implement a quality control plan for aggregate production.
- 9.2.1. The quality control plan shall detail the production procedures, testing methods, and testing frequencies that will be used to ensure that recycled concrete aggregate meets the requirements of this specification.

- 9.2.2. The quality control plan will detail the production procedures and methods to ensure consistent production of aggregate from reclaimed concrete.
- 9.2.3. Detail methods to ensure that reclaimed concrete source materials are not contaminated with extraneous solid waste or hazardous materials. Methods and criteria for examining reclaimed concrete materials prior to use should be established.
- 9.3. Stockpiling will be required to assist in qualitatively and quantitatively identifying the presence of deleterious materials. Stockpiling can also be used as a means to qualitatively assess the uniformity of the material. The stockpile may represent all or part of the material to be used on a project and should be constructed in a manner that will minimize segregation and permit visual examination and representative sampling of the material.
- 9.4. If reclaimed concrete aggregate is blended with other approved aggregates, this shall be accomplished by mechanical interlock blending or belt blending to ensure uniform proportioning.
Note 12—Other methods of blending shall be permissible if it can be demonstrated through sampling and testing that the alternate blending method will prevent segregation.
- 9.5. Reclaimed concrete aggregate shall be saturated with water for a time period that is sufficient to saturate all particles, prior to introducing the reclaimed concrete aggregate into a concrete mix, by means of a water sprinkling system or another approved method. At the time of batching, the reclaimed concrete aggregate shall contain water in excess of the saturated surface-dry condition. Provision shall also be made for the free drainage of excess water.

APPENDIXES

(Nonmandatory Information)

X1. SPECIFIC GRAVITY AND WATER ABSORPTION

- X1.1. The specific gravity of reclaimed concrete aggregate from different sources can be expected to vary. Such fluctuations in specific gravity properties are undesirable in a concrete aggregate material. Because concrete is batched on the principle of weighing the components, the effect on the volume of material measured when the specific gravity varies may be significant. These potential variations can affect the yield of the mix, the cement factor, and the engineering properties of the concrete mixture.
- X1.1.1. A technique to control the variability of specific gravity properties of reclaimed concrete aggregate is to use the source approval method. In this approach, the state or other jurisdiction specifies what materials within the limits of the project are suitable for recycling into reclaimed concrete aggregate. The concrete to be recycled generally contains aggregate from one source, where little variation in specific gravity can be expected.
- X1.1.2. An alternative to the source approval approach is for the engineer to monitor the physical properties of the fresh concrete, including yield, to determine if specific gravity variations result in property changes. Standard practices of adjusting batch weights to correct yield should be followed. A ± 3.0 percent variation in yield should require batch weight adjustments.
- X1.2. Reclaimed concrete aggregate can be expected to exhibit higher and more variable water absorption properties than conventional aggregates. This is due to the presence of a highly absorptive mortar component of the original concrete material adhering to the aggregate particles.

- X1.2.1. The primary effect on the quality of the concrete manufactured using aggregate with high water absorptive properties is to draw the free water that is present in the mortar of the fresh concrete into the pore structure of the aggregate. The net effect of this process is to reduce the water in the mortar, thus resulting in an early setting of the concrete and an early loss in workability.
- X1.2.2. Because the fine portion (material passing the 2.36-mm (No. 8) sieve) of reclaimed concrete aggregate will contain the predominant fraction of high-absorption material in the recycled concrete aggregate, eliminating the fine portion from the source material can be utilized as a means to mitigate this problem.
- X1.2.3. High-absorption problems can be further mitigated by requiring that coarse reclaimed concrete aggregate contains water in excess of the saturated surface-dry condition prior to mixing it with cement and water. During this process, steps must also be taken to ensure that excess water readily drains from the reclaimed concrete aggregate material. This process ensures that the internal voids in the aggregate particles are filled with water at the time of batching of the concrete, eliminating any additional water demand.

X2. METHODS FOR EVALUATING POTENTIAL REACTIVITY OF AN AGGREGATE

- X2.1. A number of methods for detecting potential reactivity have been proposed. However, they do not provide quantitative information on the degree of reactivity to be expected or tolerated in service. Therefore, the evaluation of the potential reactivity of an aggregate must be based upon judgment and on the interpretation of test data and examination of concrete structures containing a combination of fine and coarse aggregates and cements for use in the new work. For the test methods listed in this appendix, note that the required aggregate gradation shall be obtained by crushing the coarse RCA intended for use in the concrete. Fine aggregate produced from initial processing of the reclaimed concrete has been found to inaccurately represent the reactivity of the coarse RCA. A listing of suggested test methods follows:
- X2.1.1. *T 299-93 (2009)(discontinued)*—This rapid test method is intended to be used in conjunction with other tests to determine the presence of alkali-silica reaction (ASR) products in hardened concrete. A solution of uranyl acetate is applied to the fractured surface of hardened concrete. The reagent reacts with the sodium- and potassium-rich ASR gel present on the fractured surface of the concrete in such a manner that the uranium ions are absorbed by these gels. If sodium- and potassium-rich ASR gels are present on the fractured surface of the uranyl-acetate treated concrete, the areas in which the gel is concentrated will effloresce a bright yellow-green. However, both expansive and non-expansive sodium- and potassium-rich ASR gels will effloresce after exposure to a uranyl-acetate solution. This test, therefore, can only be used as an indicator that ASR may be present. A positive test then indicates that further evaluation is required. If sodium silicates are present, the light will effloresce. The use of this test method may be restricted by local environmental requirements because of the use of a uranyl-acetate solution.
- X2.1.2. *T 303*—In this 16-day test, hardened mortar bars consisting of portland cement and the crushed suspect aggregate are subjected to submersion in a standard sodium hydroxide solution. The specimens are measured both before and after the 16-day submersion in the solution. If the specimens expand more than 0.10 percent, there is a strong probability that reactive aggregates are present.
- X2.1.3. *ASTM C 295*—Certain materials are known to be reactive with the alkalis in cements. These include the following forms of silica: opal, chalcedony, tridymite, and cristobalite; intermediate to

acid (silica-rich) volcanic glass such as is likely to occur in rhyolite, andesite, or dacite; and certain constituents of some phyllites. Determination of the presence and quantities of these materials by petrographic examination is helpful in evaluating potential alkali reactivity. Some of these materials render an aggregate deleteriously reactive when present in quantities as small as 1.0 percent.

- X2.1.4. *ASTM C 289*—This test method covers chemical determination of the potential reactivity of an aggregate with alkalis in concrete as indicated by the amount of reaction during 24 h at 80°C between 1N sodium hydroxide solution and aggregate that has been crushed and sieved to pass a 300-μm (No. 50) sieve and be retained on a 150-μm (No. 100) sieve. Test results from ASTM C 289, which indicate that the aggregate is nonreactive, should not be used as a final determination that the aggregate is indeed nonreactive. Many aggregates which react very slowly to cause deleterious expansion from alkali-silica reactivity have tested as nonreactive in ASTM C 289. In addition to ASTM C 289, the aggregate should be subjected to at least one of the following additional tests: T 303, ASTM C 295, or ASTM C 1293.
- X2.1.5. *ASTM C 342*—This test method is intended primarily for research concerning the potential expansion of cement-aggregate combinations subjected to variations of temperature and water saturation during storage under prescribed conditions of test.
- X2.1.6. *ASTM C 586*—The reaction of the dolomite in certain carbonate rocks with alkalis in hydraulic cement paste has been found to be associated with the deleterious expansion of concrete containing such rocks as coarse aggregate. Carbonate rocks capable of such reactions possess a characteristic texture and composition. The characteristic texture is that in which large crystals of dolomite are scattered in a finer grained matrix of calcite and clay. The characteristic composition is that in which the carbonate portion consists of substantial amounts of both dolomite and calcite, and the acid-insoluble residue contains a significant amount of clay. This method has been successfully used in (1) research and (2) preliminary screening of aggregate sources to indicate the presence of material with a potential for deleterious expansions when used in concrete.
- X2.1.7. *T 161*—This test method applies freeze-thaw cycling to hardened concrete samples. The object of the test is to determine the potential of the aggregate used in the concrete to expand as a result of freeze-thaw action.
- X2.1.8. *ASTM C 856*—An effective method of determining the nature of aggregate materials to react with alkali components of hydraulic cement to form alkali-silica reaction products is to perform a petrographic analysis of hardened concrete. The suspect concrete material is cut with a diamond saw into slices that are called thin sections. The thin sections are then studied with a petrographic microscope to determine if a reaction has taken place.
- X2.1.9. *ASTM C 227*—A relatively long test in which mortar bars containing the test aggregate and cement are stored in sealed containers at 100°F for periods up to six months, or more. The test is relatively slow and allows potentially deleterious aggregate or cement-aggregate combinations to pass.

¹ This provisional standard was first published in 2007.

Standard Specification for Uncoated, Corrosion-Resistant, Deformed and Plain Alloy, Billet-Steel Bars for Concrete Reinforcement and Dowels

AASHTO Designation: MP 18M/MP 18-09 (2013)¹



**American Association of State Highway and Transportation Officials
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001**

Uncoated, Corrosion-Resistant, Deformed and Plain Alloy, Billet- Steel Bars for Concrete Reinforcement and Dowels

AASHTO Designation: MP 18M/MP 18-09 (2013)¹



1. SCOPE

- 1.1. This specification covers uncoated, corrosion-resistant, deformed and plain alloy, billet-steel concrete reinforcement and dowel bars in cut lengths or coils, where corrosion-resistant performance may be essential (Notes 1 and 2). The standard sizes and dimensions of deformed bars and their number designations shall be those listed in Table 2 [Table 3].
- Note 1**—For coils of deformed bars, the capacity of industrial equipment limits the maximum bar size that can be straightened.
- Note 2**—The degree of corrosion resistance needed for a specific use is dependent on both the project's environmental conditions and its application.
- Comparative corrosion performance data in accordance with Section 11 and Annex A shall apply only when specified by the purchaser.
- 1.2. Bars are of three minimum yield levels: 420 MPa [60,000 psi], 520 MPa [75,000 psi], and 690 MPa [100,000 psi], designated as Grade 420 [60], Grade 520 [75], and Grade 690 [100], respectively.
- 1.3. Hot-rolled plain rounds, in sizes up to and including 50.8 mm [2 in.] in diameter in coils or cut lengths, when specified for dowels, spirals, and structural ties or supports, shall be furnished under this specification in Grade 420 [60], Grade 520 [75], and Grade 690 [100] (Note 3).
- For ductility properties, test provisions of the nearest nominal diameter deformed bar size shall apply. Those requirements providing for deformations and marking shall not be applicable (Note 3).
- Note 3**—The weight for plain rounds smaller than 9.5 mm [$\frac{3}{8}$ in.] in diameter shall be computed on the basis of the size in ASTM A 510M [ASTM A 510].
- Note 4**—Welding of the material in this specification should be approached with caution since no specific provisions have been included to enhance its weldability. When the steel is to be welded, a welding procedure suitable for the chemical composition and intended use or service should be used.
- 1.4. This specification is applicable for orders in either SI units (as Specification MP 18M) or in inch-pound units (as Specification MP 18). SI units and inch-pound units are not necessarily equivalent. Inch-pound units are shown in brackets in the text for clarity, but they are the applicable values when the material is ordered to MP 18.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards:*

- M 31M/M 31, Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- T 244, Mechanical Testing of Steel Products
- T 285, Bend Test for Bars for Concrete Reinforcement

2.2. *ASTM Standards:*

- A 484/A 484M, Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
- A 510/A 510M, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
- A 700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment
- A 751, Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- A 955/A 955M, Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement
- A 1035/A 1035M, Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement
- E 29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

2.3. *Military Standards:*

- MIL-STD-129, Marking for Shipment and Storage
- MIL-STD-163, Steel Mill Products Preparation for Shipment and Storage

2.4. *Federal Standard:*

- Fed. Std. No. 123, Marking for Shipment (Civil Agencies)

3. TERMINOLOGY

3.1. *Description of Terms Specific to This Standard:*

3.1.1. *deformed bar*—steel bar with protrusions; a bar that is intended for use as reinforcement in reinforced concrete construction.

3.1.1.1. *Discussion*—The surface of the bar is provided with lugs or protrusions that inhibit longitudinal movement of the bar relative to the concrete surrounding the bar in such construction. The lugs or protrusions conform to the provisions of this specification.

3.1.2. *deformations*—protrusions on a deformed bar.

3.1.3. *plain bar*—steel bar without protrusions.

3.1.4. *rib*—longitudinal protrusion on a deformed bar.

3.1.5. *lot*—bars of one bar number and pattern of deformation contained in an individual shipping release or shipping order.

4. ORDERING INFORMATION

- 4.1. Orders for material under this specification should include the following information:
 - 4.1.1. Quantity (mass) [weight];
 - 4.1.2. Name of material (uncoated, corrosion-resistant, deformed and plain alloy, billet-steel bars for concrete reinforcement and dowels);
 - 4.1.3. Size;
 - 4.1.4. Cut length or coils;
 - 4.1.5. Deformed or plain;
 - 4.1.6. Grade;
 - 4.1.7. Packaging (see Section 22);
 - 4.1.8. AASHTO designation and year of issue; and
 - 4.1.9. Certified mill test reports (if desired).

Note 5—A typical ordering description is as follows: “10-Mg, uncoated, corrosion-resistant, deformed and plain alloy, billet-steel bars for concrete reinforcement and dowels, No. 25, 18 m long, deformed, Grade 520, in secured lifts, to MP 18M-___. Certified mill test reports are required. [10-ton, uncoated, corrosion-resistant, deformed and plain alloy, billet-steel bars for concrete reinforcement and dowels, No. 8, 60 ft 0 in. long, deformed, Grade 75 in secured lifts, to MP 18-___. Certified mill test reports are required.]”

5. MATERIALS AND MANUFACTURE

- 5.1. The bars shall be rolled from properly identified heats of mold cast or strand cast steel.

6. CHEMICAL REQUIREMENTS

- 6.1. The chemical analysis of each heat shall be determined in accordance with ASTM A 751. The manufacturer shall make the analysis on test samples taken preferably during the pouring of the heat. The percentages of carbon, chromium, copper, manganese, molybdenum, nickel, nitrogen, phosphorus, silicon, sulfur, and vanadium shall be determined and reported as required in Section 20.
- 6.2. The analysis of the heat shall be made by the manufacturer and shall conform to the analysis tolerances specified in Table 1 of ASTM A 484/A 484M when compared to the chemistry reported in Annex A, Section A1.6.3.
 - 6.2.1. A product check made by the purchaser shall conform to the analysis tolerances specified in Table 1 of ASTM A 484/A 484M when compared to the chemistry reported in Annex A, Section A1.6.3.
- 6.3. The chemical composition as shown by heat analysis shall be limited by Table 1.

Table 1—Maximum Chemical Constituents
(Weight %) Except as Indicated

Element	Amount
Carbon	0.15%
Chromium	9.2% (Min)
Manganese	2.0%
Nitrogen	0.20%
Phosphorus	0.045%
Silicon	1.0%
Sulfur	0.030%

7. REQUIREMENTS FOR DEFORMATIONS

- 7.1. Deformations shall be spaced along the bar at substantially uniform distances. The deformations on opposite sides of the bar shall be similar in size, shape, and pattern.
- 7.2. The deformations shall be placed with respect to the axis of the bar so that the included angle is not less than 45 degrees. Where the line of deformations forms an included angle with the axis of the bar from 45 to 70 degrees inclusive, the deformations shall alternately reverse in direction on each side, or those on one side shall be reversed in direction from those on the opposite side. Where the line of deformation is greater than 70 degrees, a reversal in direction is not required.
- 7.3. The average spacing or distance between deformations on each side of the bar shall not exceed seven-tenths of the nominal diameter of the bar.
- 7.4. The overall length of deformations shall be such that the gap between the ends of the deformations on opposite sides of the bar shall not exceed 12.5 percent of the nominal perimeter of the bar. Where the ends terminate in a longitudinal rib, the width of the longitudinal rib shall be considered the gap. Where more than two longitudinal ribs are involved, the total width of all longitudinal ribs shall not exceed 25 percent of the nominal perimeter of the bar; furthermore, the summation of gaps shall not exceed 25 percent of the nominal perimeter of the bar. The nominal perimeter of the bar shall be 3.14 times the nominal diameter.
- 7.5. The spacing, height, and gap of deformations shall conform to the requirements prescribed in Table 2 [Table 3].

Table 2—Deformed Bar Designation Numbers, Nominal Masses, Nominal Dimensions, and Deformation Requirements, SI Units

Bar Designation No. ^a	Nominal Mass, kg/m	Nominal Dimensions ^b			Deformation Requirements, mm		
		Diameter, mm	Cross-Sectional Area, mm ²	Perimeter, mm	Maximum Average Spacing	Minimum Average Height	Maximum Gap (Chord of 12.5% of Nominal Perimeter)
10	0.560	9.5	71	29.9	6.7	0.38	3.6
13	0.994	12.7	129	39.9	8.9	0.51	4.9
16	1.552	15.9	199	49.9	11.1	0.71	6.1
19	2.235	19.1	284	59.8	13.3	0.97	7.3
22	3.042	22.2	387	69.8	15.5	1.12	8.5
25	3.973	25.4	510	79.8	17.8	1.27	9.7
29	5.060	28.7	645	90.0	20.1	1.42	10.9
32	6.404	32.3	819	101.3	22.6	1.63	12.4
36	7.907	35.8	1006	112.5	25.1	1.80	13.7
43	11.38	43.0	1452	135.1	30.1	2.16	16.5
57	20.24	57.3	2581	180.1	40.1	2.59	21.9

^a Bar numbers approximate the number of millimeters of the nominal diameter of the bar.

^b The nominal dimensions of a deformed bar are equivalent to those of a plain round bar having the same mass per meter as the deformed bar.

Table 3—Deformed Bar Designation Numbers, Nominal Weights, Nominal Dimensions, and Deformation Requirements, U.S. Customary Units

Bar Designation No. ^a	Nominal Weight, lb/ft	Nominal Dimensions ^b			Deformation Requirements, in.		
		Diameter, in.	Cross-Sectional Area, in. ²	Perimeter, in.	Maximum Average Spacing	Minimum Average Height	Maximum Gap (Chord of 12.5% of Nominal Perimeter)
3	0.376	0.375	0.11	1.178	0.262	0.015	0.143
4	0.668	0.500	0.20	1.571	0.350	0.020	0.191
5	1.043	0.625	0.31	1.963	0.437	0.028	0.239
6	1.502	0.750	0.44	2.356	0.525	0.038	0.286
7	2.044	0.875	0.60	2.749	0.612	0.044	0.334
8	2.670	1.000	0.79	3.142	0.700	0.050	0.383
9	3.400	1.128	1.00	3.544	0.790	0.056	0.431
10	4.303	1.270	1.27	3.990	0.889	0.064	0.487
11	5.313	1.410	1.56	4.430	0.987	0.071	0.540
14	7.65	1.693	2.25	5.32	1.185	0.085	0.648
18	13.60	2.257	4.00	7.09	1.58	0.102	0.864

^a Bar numbers are based on the number of eighths of an inch included in the nominal diameter of the bars.

^b The nominal dimensions of a deformed bar are equivalent to those of a plain round bar having the same weight per foot as the deformed bar.

8. MEASUREMENTS OF DEFORMATIONS

- 8.1. The average spacing of deformations shall be determined by measuring the length of a minimum of ten spaces and dividing that length by the number of spaces included in the measurement. The measurement shall begin from a point on a deformation at the beginning of the first space to a corresponding point on a deformation after the last included space. Spacing measurements shall not be made over a bar area containing bar marking symbols involving letters or numbers.
- 8.2. The average height of deformations shall be determined from measurements made on not fewer than two typical deformations. Determinations shall be based on three measurements per deformation, one at the center of the overall length and the other two at the quarter points of the overall length.

- 8.3. Insufficient height, insufficient circumferential coverage, or excessive spacing of deformations shall not constitute cause for rejection unless it has been clearly established by determinations on each lot tested that typical deformation height, gap, or spacing do not conform to the minimum requirements prescribed in Section 7. No rejection may be made on the basis of measurements if fewer than ten adjacent deformations on each side of the bar are measured.

9. TENSILE REQUIREMENTS

- 9.1. The material, as represented by the test specimens, shall conform to the requirements for tensile properties prescribed in Table 4 [Table 5].
- 9.2. The yield point or yield strength shall be determined by the offset method (0.2 percent offset), described in Section 13.2 of T 244. When material is furnished in coils, the test sample must be straightened prior to placing it in the jaws of the tensile machine. Straightening shall be done carefully to avoid the formation of local sharp bends and to minimize cold work. Insufficient straightening before attaching the extensometer can result in lower-than-actual yield strength readings.
- 9.3. The percentage of elongation shall be as prescribed in Table 4 [Table 5] when tested in accordance with Section 13.4 of T 244.

Table 4—Tensile Properties Requirements, SI Units

	Grade 420	Grade 520	Grade 690
	Tests of Full Bar Cross Section		
Tensile strength, min, MPa	620	690	1030
Yield strength, min, MPa	420	520	690
Elongation in 203.2 mm, min %:			
Bar designation no.:			
10	9	7	7
13, 16	9	7	7
19	9	7	7
22, 25	8	7	7
29, 32, 36	7	7	7
43, 57	7	6	6

Table 5—Tensile Properties Requirements, U.S. Customary Units

	Grade 60	Grade 75	Grade 100
	Tests of Full Bar Cross Section		
Tensile strength, min, psi	90,000	100,000	150,000
Yield strength, min, psi	60,000	75,000	100,000
Elongation in 8 in., min %:			
Bar designation no.:			
3	9	7	7
4, 5	9	7	7
6	9	7	7
7, 8	8	7	7
9, 10, 11	7	7	7
14, 18	7	6	6

10. BENDING REQUIREMENTS

- 10.1. The bend-test specimen shall withstand being bent around a pin without cracking on the outside of the bent portion when tested in accordance with T 285. The requirements for angle of bending and sizes of pins are prescribed in Table 6 [Table 7]. When material is furnished in coils, the test sample must be straightened prior to placing it in the bend tester.

Table 6—Bend-Test Requirements, SI Units

	Grade 420	Grade 520	Grade 690
Bar Designation No.	Pin Diameter for Bend Tests ^a		
10, 13, 16	3.5 d^b	3.5 d	3.5 d
19	5 d	5 d	5 d
22, 25	5 d	5 d	5 d
29, 32, 36	7 d	7 d	7 d
43, 57 (90°)	9 d	9 d	^c

^a Test bends 180° unless otherwise agreed.

^b d = nominal diameter of specimen

^c These bars are only used in straight lengths.

Table 7—Bend-Test Requirements, U.S. Customary Units

	Grade 60	Grade 75	Grade 100
Bar Designation No.	Pin Diameter for Bend Tests ^a		
3, 4, 5	3.5 d^b	3.5 d	3.5 d
6	5 d	5 d	5 d
7, 8	5 d	5 d	5 d
9, 10, 11	7 d	7 d	7 d
14, 18 (90°)	9 d	9 d	^c

^a Test bends 180° unless otherwise agreed.

^b d = nominal diameter of specimen

^c These bars are only used in straight lengths.

- 10.2. The bend test shall be made on specimens of sufficient length to ensure free bending and with an apparatus that provides:

- 10.2.1. Continuous and uniform application of force throughout the duration of the bending operation.

- 10.2.2. Unrestricted movement of the specimen at points of contact with the apparatus and bending around a pin free to rotate.
- 10.2.3. Close wrapping of the specimen around the pin during the bending operation.
- 10.3. Other acceptable more severe methods of bend testing, such as placing a specimen across two pins free to rotate and applying the bending force with a fixed pin, may be used. When failures occur under more severe methods, retests shall be permitted under the bend-test method prescribed in Section 10.2.

11. COMPARATIVE CORROSION RESISTANCE PERFORMANCE (PURCHASER SPECIFIED)

- 11.1. Comparative corrosion performance data for chromium containing steels (e.g., ASTM A 955/A 955M and ASTM A 1035/A 1035M) shall be furnished, based on mutual agreement between the manufacturer and the purchaser, as described in Annex A.

12. PERMISSIBLE VARIATION IN MASS [WEIGHT]

- 12.1. The permissible variation shall not exceed 6 percent under nominal mass [weight] except for bars smaller than 9.5 mm [$\frac{3}{8}$ in.] plain round. The permissible variation in mass [weight] shall be computed upon the basis of the permissible variation in diameter in ASTM A 510M [ASTM A 510]. Reinforcing bars are evaluated on the basis of nominal mass [weights]. In no case shall the overmass [overweight] of any bar be the cause for rejection.
- 12.2. The specified limit of variation shall be evaluated in accordance with ASTM E 29 (rounding method).

13. FINISH

- 13.1. The bar shall be free of detrimental surface imperfections.
- 13.2. Seams, surface irregularities, or mill scale oxidation shall not be cause for rejection, provided the weight, dimensions, cross-sectional area, and tensile properties are not less than the requirements of this specification.
- 13.3. Surface imperfections other than those specified in Section 13.2 shall be considered detrimental when specimens containing such imperfections fail to conform to either tensile or bending requirements. Examples include but are not limited to laps, seams, scabs, slivers, cooling or casting cracks, and mill or guide marks (Note 6).
- Note 6**—Deformed bars intended to be mechanically spliced or butt-welded may require a certain degree of roundness in order for the splices to adequately achieve strength requirements.

14. TEST SPECIMENS

- 14.1. Tension test specimens shall be the full section of the bar as rolled. The unit stress determinations on full-sized specimens shall be based on the nominal bar area.
- 14.2. The bend-test specimens shall be the full section of the bar as rolled.

15. NUMBER OF TESTS

- 15.1. For bar sizes No. 10 to 36 [No. 3 to 11], inclusive, one tension test and one bend test shall be made of the largest size rolled from each heat. If, however, material from one heat differs by three or more designation numbers, one tension and one bend test shall be made from both the highest and lowest designation number of the deformed bars rolled.
- 15.2. For bar sizes No. 43 and No. 57 [No. 14 and No. 18] bars, one tension test and one bend test shall be made of each size from each heat.

16. RETESTS

- 16.1. If any tensile property of any tension test specimen is less than that specified, and any part of the fracture is outside the middle third of the gauge length, as indicated by scribe marks on the specimen before testing, a retest shall be allowed.
- 16.2. If the results of an original tension specimen fail to meet the specified minimum requirements and are within 14 MPa [2000 psi] of the required tensile strength, within 7 MPa [1000 psi] of the required yield point, or within 2 percentage units of the required elongation, a retest shall be permitted on two random specimens for each original tension specimen failure from the lot. If all results of these retest specimens meet the specified requirements, the lot shall be accepted.
- 16.3. If a bend test fails for reasons other than mechanical reasons or flaws in the specimen as described in Sections 16.4 and 16.7, retest shall be permitted on two random specimens from the same lot. If the results of both test specimens meet the specified requirements, the lot shall be accepted. The retest shall be performed on test specimens that are at air temperature but not less than 16°C [60°F].
- 16.4. If a mass [weight] test fails for reasons other than flaws in the specimen as described in Section 16.7, a retest shall be permitted on two random specimens from the same lot. Both retest specimens shall meet the requirements of this specification.
- 16.5. If any test specimen fails because of mechanical reasons such as failure of testing equipment or improper specimen preparation, it may be discarded and another specimen taken.
- 16.6. If a corrosion resistance test fails for reasons other than flaws as described in Section 16.7, a retest shall be permitted on two random specimens from the same lot. Both retest specimens shall meet the requirements of this specification.
- 16.7. If any test specimen develops flaws, it may be discarded and another specimen of the same size bar from the same heat may be substituted.

17. INSPECTION

- 17.1. The inspector representing the purchaser shall have free entry, at all times, while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him or her that the material is being furnished in accordance with this specification. All tests (except product analysis) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

- 17.2. *For Government Procurement Only*—Except as otherwise specified in the contract, the contractor is responsible for the performance of all inspection and test requirements specified herein and may use his or her own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser at the time of purchase. The purchaser shall have the right to perform any of the inspections and tests at the same frequency as set forth in this specification, where such inspections are deemed necessary to assure that material conforms to prescribed requirements.

18. REJECTION

- 18.1. Unless otherwise specified, any rejection based on tests made in accordance with Section 6.3 shall be reported to the manufacturer within five working days from the receipt of samples by the purchaser.
- 18.2. Material that shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

19. REHEARING

- 19.1. Samples tested in accordance with Section 6.2 that represent rejected material shall be preserved for two weeks from the date rejection is reported to the manufacturer. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

20. TEST REPORTS

- 20.1. Test reports should include the following:
- 20.1.1. Chemical analysis, including percentages of carbon, chromium, copper, manganese, molybdenum, nickel, nitrogen, phosphorus, silicon, sulfur, and vanadium;
- 20.1.2. Tensile properties;
- 20.1.3. Bend test;
- 20.1.4. Comparative corrosion performance data (if appropriate); and
- 20.1.5. *Qualification Test*—Annex A (Purchaser specified) with chemical analysis tolerances conforming to Section 6.2.

21. MARKING

- 21.1. When loaded for mill shipment, bars shall be properly separated and tagged with the manufacturer's heat or test identification number.
- 21.2. Each producer shall identify the symbols of his marking system.
- 21.3. All bars produced to this specification, except plain round bars, which shall be tagged for grade, shall be identified by a distinguishing set of marks legibly rolled into the surface of one side of the bar to denote, in the following order:
- 21.3.1. *Point of Origin*—Letter or symbol established as the producer's mill designation.

- 21.3.2. *Size Designation*—Arabic number corresponding to bar designation number of Table 2 [Table 3].
- 21.3.3. *Type of Steel*—Letters “CS” indicating that the bar was produced to this specification.
- 21.3.4. *Minimum Yield Designation*—For Grade 420 [60] bars, either the number 4 [60] or a single continuous longitudinal line through at least five spaces offset from the center of the bar side. For Grade 520 [75] bars, either the number 5 [75] or two continuous longitudinal lines through at least five spaces offset each direction from the center of the bar. For Grade 690 [100] bars, either the number 6 [100] or three continuous longitudinal lines through at least five spaces offset each direction from the center of the bar.
- 21.3.5. It shall be permissible to substitute a metric size bar of Grade 420 for the corresponding inch-pound size bar of Grade 60, a metric size bar of Grade 520 for the corresponding inch-pound size bar of Grade 75, and a metric size bar of Grade 690 for the corresponding inch-pound size bar of Grade 100.

22. PACKAGING

- 22.1. When specified in the purchase order, packaging shall be in accordance with the procedures in ASTM A 700.
- 22.2. *For Government Procurement Only*—When specified in the contract or order, and for direct procurement by or direct shipment to the U.S. government, material shall be preserved, packaged, and packed in accordance with the requirements of MIL-STD-163. The applicable levels shall be as specified in the contract. Marking for shipment of such material shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

23. KEYWORDS

- 23.1. Alloy steel bars; concrete reinforcement; corrosion-resistant; deformations (protrusions); dowels.